Impacts of different representations of SOA on simulated trends: multi-model analysis in the framework of the Eurodelta-Trends exercise

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Particulate organic matter represents an important fraction of $PM_{2.5}$ mass in Europe (20 to 60%). The Chemistry Transport Models (CTM) tend to under-estimate secondary organic aerosol (SOA) concentrations and the causes are still poorly understood, due to the complexity of the formation process and the large number of species involved, originating from anthropogenic and biogenic sources. The formation of SOA is one of the topics addressed in the context of the Eurodelta-Trends exercise.

For this exercise a common set of input data (meteorology, emissions, and boundary conditions) covering Europe for a twenty years period (1990-2010) has been developed. Seven regional models are used within this exercise (Chimere, CMAQ, MINNI, LOTOS-EUROS, EMEP-MSCW, Polyphemus, and WRF-Chem) to perform simulations at 25km resolution. In this work the SOA simulated by each participating model are compared for the three reference years (1990, 2000, and 2010).

For the three years the models show similar features: similar anthropogenic SOA (ASOA) spatial distributions, but with large variability between models in terms of concentration levels. The same tendency is observed for the anthropogenic VOC, from which ASOA are formed. Concerning the biogenic fraction of SOA (BSOA), the results show a large variability in the spatial distributions while the distributions of the biogenic VOC emissions are similar.

These differences can be attributed to the various oxidation processes included in the models, leading to different patterns of SOA precursors, formed from the oxidation of the emitted VOC. Furthermore, the gas phase chemical mechanisms and organic aerosol models are different for each regional model, leading to differences in the SOA precursor concentrations and in the gas/particles partitioning.

Finally, the SOA analysis is extended to the whole Eurodelta-Trends period (1990-2010), in order to study the impact of these differences on the simulated trends over Europe during the last twenty years.